flowers age, the nectar becomes an almost black, gelatinous lump adhering to the base of the flowers. This phenomenon was observed in plants inspected at Armadale, Maddington, Kings Park (cultivated in the Botanic Garden), and in the vicinity of Geraldton and Walkaway.

Green nectar was most abundant on flower heads opening during fine weather following autumn showers a few days before (May-June). The dark mucilage usually formed a skin over the drop of nectar which remained liquid inside. With greater output, green nectar would flow over the flowers, down the leaves and stems and onto the ground. Nectar production fell during prolonged dry weather, and continual rain in later months washed off the nectar soon after exudation, so that in both cases little mucilage accumulated.

High power microscopic examination of the green, mucilaginous nectar revealed abundant filamentous and unicellular blue-green algae embedded in green mucilage. Pollen grains of *Banksia* aff. *sphaerocarpa* were always present. None had germinated, while bacteria often adhered to them.

Yeasts were sometimes observed, and these no doubt contributed to the 'musty' smell of the flowers. Some of the densely-packed, branching filaments lacked thick-walled heterocysts *(Nostochopsis?)*, while in others about 10% of the cells were heterocystous. Large, spore-like akinetes were abundant in old nectar. These were penultimate to a terminal heterocyst *(Cylindrospermum, Wollea?*, both common in soil) or less frequently, between two heterocysts *(Nostoc, Anabaena?*, both common in soil). Larger, multicellular hormogonia were sometimes seen.

Are these blue-green algae incidental in the nectar, or do they have some functional significance? The skin of mucilage would certainly reduce evaporation and hence prolong the attractiveness of the flowers via nectar and odour. Nevertheless, at least the Cannington form of this species complex is completely self-fertile, even in the absence of pollinators (Lamont, unpub.). These algae may even produce sufficient toxins (well-known in aquatic species) to deter animal visitors. On the other hand, the abundance of heterocysts indicates considerable potential for fixation of atmospheric nitrogen and its conversion into ammonia and thence amino acids. In this case, the nectar may be a valuable protein supplement, as well as energy source, for pollinators. In view of this species' highly infertile sandy (dry or winter-waterlogged) habitats, this unusual symbiosis may well have a more direct function: a source of supplementary nitrogen for the plant. Nitrogen compounds would be washed or carried soon after synthesis onto the mat of proteoid roots under the canopy. Even blue-green algae which will only fix nitrogen in the presence of fructose, a standard component of nectar, would be accommodated by this system. Further studies are continuing.

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LONG RANGE SIGHTINGS OF BUSH FIRES AS A POSSIBLE INCENTIVE FOR PLEISTOCENE VOYAGES TO GREATER AUSTRALIA

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Birdsell (1977) compares alternative Indonesian island routes (Figure 1, inset) possibly used by Pleistocene voyagers to Greater Australia and estimates the shortest seaway distances existing during glacial maxima at c. 20,000 and c. 53,000 yr BP, periods when the sea around northern Australia is estimated by Chappell (1976) to have been as much as 150 m below present sea level. Then and during the more frequent episodes over the past 120,000 years when sea level was 20-80 m below that of the present (cf. Chappell, 1976, Figure 1) smoke and glare of naturally caused bush fires on the exposed Sahul Shelf should have been visible from several

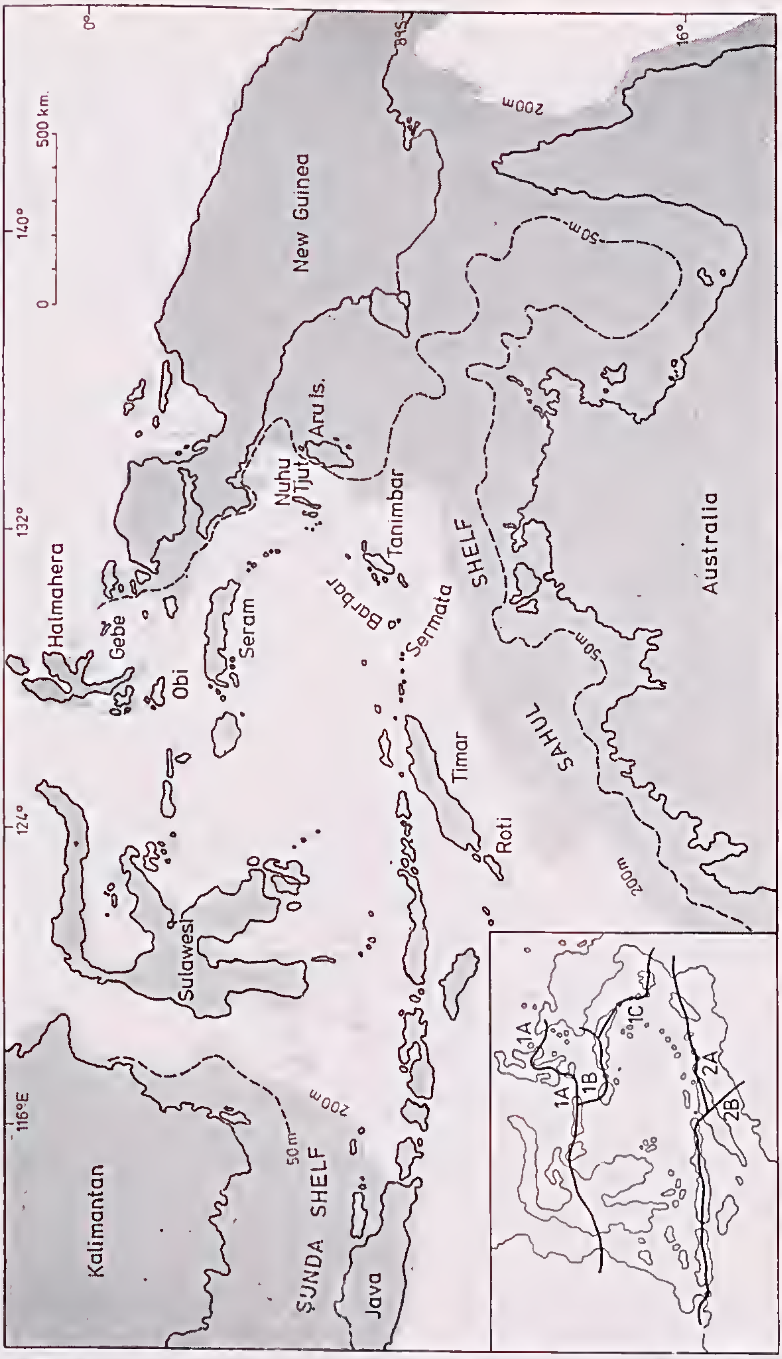

Fig. 1.—Eastern Indonesia and Greater Australia (after Birdsell, 1977, Fig. 1). Following Chappell (1976) and Webster and Stretten (1972) the 200 m isobath represents approximate coastlines during glacial maxima. The 50 m isobath is shown by a dashed line. Inset shows alternative island routes possibly used by Pleistocene voyagers to Australia.

Indonesian islands, and could have provided incentive for voyages to Greater Australia.

Little information is available for the climate of the Sahul Shelf at 53,000 yr BP or at previous glacial maxima. However it seems reasonable to suggest that these climates were similar to the better known regional climate of the last glacial maximum. At that time northward displacement of tropical cyclones and westerlies, cooler sea temperatures, and the presence of larger land masses could have provided generally cooler and drier conditions than at present (Bowler *et al.*, 1976; CLIM*AP* 1976; Fairbridge, 1965; van Andel *et al.*, 1967; Webster & Stretten, 1978). Vegetation on the Sahul Shelf at c. 18,000 yr BP is considered to have been semi-arid savanna, open woodland and woodland (Mayr, 1944; Nix & Kalma, 1972; van Andel *et al.*, 1967; Webster & Stretten, 1972). Such formations existing during glacial maxima are likely to have been prone to fire as semi-arid Australian vegetation is at present.

Fires caused by lightning are well documented for all parts of Australia (Anon., 1967; Jones, 1968; King, 1963; Naveh, 1975; Preiss, 1968; Royal Commission Report 1961; Personal communication: F. Edmunson, Chairman, State Lightning Committee, State Energy Commission, Western Australia). The present frequency of thunder days (a measure of probability of lightning strikes) in northern Australian sclerophyll woodland areas is about 30-50 days per annum (Anon., 1967), a frequency possibly higher than that of the cooler, perhaps less turbulent regional conditions during glacial periods. Even so it is probable that lightning caused fires in northern Australia throughout the late Quaternary, and that the vegetation postulated for the Sahul Shelf is likely periodically to have been sufficient to support fires of the intensity recorded in modern Australian sclerophyll formations (Baxter *et al.*, 1967; Cochrane, 1966; Vines, 1970).

A mariners' distance calculation (Lecky, 1956):

$$\sqrt{\text{observer's height in feet above sea level}} + \sqrt{\text{object height in feet above sea level}} = \text{distance observable in nautical miles}$$

can be used to show that 1,000 m high smoke plumes produced by relatively small bush fires should have been visible by an observer standing at sea level for distances up to 110 km, well in excess of the minimum 87 km (route 2B, Fig. 1) separating Timor/Roti from the Sahul Shelf when sea levels were lowest, and of the maximum 103 km estimated by Birdsell (1976) for the longest crossing (the last stage of route 1C, Nuhu Tjut to Sahul Shelf at Aru Islands, Figure 1) of any of his routes at 150 m below present sea level.

Increases in the heights above sea level of the observer and the object can greatly extend distances over which objects can be seen, so making possible bush fire observations when seaways between Indonesia and Greater Australia were much wider than at glacial maxima. Large bush fires under conditions of little or no wind may create convectional maelstroms which commonly reach altitudes of 5,000 m (Taylor *et al.* 1971), and have been recorded as high as 6,100 m (Vines 1975). It is possible then that under optimum sighting conditions smoke plumes reaching heights of 5,000 m or more could be seen by an observer standing 150 m above sea level from as far away as 275 km. This distance far exceeds the widths of the seaways between Indonesian islands adjacent to the Sahul Shelf on routes 1A-C and 2A when sea level was −50 m, and approximates the seaway between Timor/Roti and the partly submerged Sahul Shelf when the sea was 50-200 m below its present level (Fig. 1).

First hand observations collected by the authors support the argument that smoke and also glare of Australian bush fires can be seen over long distances. In one case a Western Australian Museum field party camped at Gregory Salt Lake (Lat. 20°10'S. Long. 127°30'E.) in a semi-arid part of north-western Australia saw the glare of a large bush fire burning in grassland and sparse open woodland 35 km NE of Sturt Creek homestead, a distance of some 160 km (personal communication: R. Johnstone and L. Smith, Western Australian Museum). It is concluded that during the Pleistocene and early Holocene human beings on several Indonesian islands (i.e. Timor/Roti, Tanimbar, Nuhu Tjut, Seram and Gebe, and possibly Sermata, Babar, Obi and Halmahera, Fig. 1) occasionally should have been able to see smoke or glare of naturally caused bush fires on the large land masses of the exposed Sahul Shelf. Such observations, perhaps in the case of the route 1 variants combined with sightings of elevated land features (Birdsell, 1977; Jennings, 1971), may have resulted in periodic, deliberate voyages to Greater Australia. This possibility is relevant to the problem of diversity recently noted among prehistoric Australian human remains (Thorne, 1977), and to the interpretation of cultural developments in Australia and New Guinea.

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FROM FIELD AND STUDY

An adult food plant of *Ethon breve* (Coleoptera: Buprestidae).—On September 23, 1979 while walking in bushland in an adjacent allotment opposite the W.A. Dept. of Agriculture, South Perth, I found, on one flower of *Patersonia occidentalis* R.Br., an individual of the jewel beetle *Ethon breve* Carter, feeding on a petal, but the insect eluded capture. 110 flowers of numerous *P. occidentalis* plants were closely examined during 1120 to 1420 hours, but only four beetles were observed on the flowers, all of which were collected. 46 flowers (42% of those examined) had feeding damage to the petals. The sexual parts (i.e. style and stamens) of 5 flowers had been eaten. Since numbers of *E. breve* appeared low at the time, it is doubtful whether all feeding damage was attributable to this beetle. I also found a grasshopper (Tettigoniidae) chewing a petal of a flower. It is possible that grasshoppers are the main insects responsible for the feeding damage observed. *Ethon* is a small genus of beetles restricted to Australia. Carter (*Proc. Linn. Soc. N.S.W.*, 48, 1923: 159-176) noted adults of *Ethon* species from around Sydney fed on *Dillwynia* and *Pultenaea* (Fabaceae). It is thus interesting to note *E. breve* feeding on a species of the Iridaceae (a monocotyledonous family).

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Further Notes on Mistletoes from the Murchison Area, W.A.—The undetermined mistletoe mentioned in my previous article (*West. Aust. Nat.*, 14, 1979: 160-161) has been identified by Mr. A. S. George (W.A. Herbarium) as *Amyema sanguineum* (F. Muell.) Dans. Barlow, (*Aust. J. Bot.*, 14, 1966: 421-499) states that this is a widespread species in northern Australia "from North West Cape to north-east Queensland in open forests and is predominantly parasitic on *Eucalyptus* spp., rarely on *Melaleuca* spp. and a few other hosts." The following Western Australian eucalypts have been recorded as hosts for *A. sanguineum* (based on collections in the W.A. Herbarium, Perth)—*Eucalyptus argillacea, E. camaldulensis, E. terminalis* and *E. tetradonta.* My collection from *E. microtheca* adds a further host record.

On April 14, 1979, *Amyema gibberulum* (Tate) Dans. was collected